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DIVISION 16 - ELECTRICAL

SECTION 16801

PAGING AND AREA WARNING SYSTEM

**04/01**

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**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**NASA - KSC**

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SECTION 16801

PAGING AND AREA WARNING SYSTEM
**04/01**

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**NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.**

**This section covers the requirements for the paging and area warning systems (PAWS). Accordingly, this section should be tailored carefully to suit project conditions and to meet project requirements.**

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PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

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**NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.**

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1.2 GENERAL REQUIREMENTS

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**NOTE: Review submittal description (SD) definitions in Section 01300, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.**

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Section 16003, "General Electrical Provisions" applies to work specified in this section.

## 1.3 SUBMITTALS

The following shall be submitted in accordance with section describing "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Connection Diagrams
Riser Diagrams
Floor Plans
Point-to-point Connections

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Amplifier
Speakers (all types)
Microphone
Mixer
Attenuator
Transformer
Wire
Cabinets
Racks

SD-10 Operation and Maintenance Data

Operations and Maintenance Manual

SD-11 Closeout Submittals

Connection Diagrams
Riser Diagrams
Floor Plans
Point-to-point connections
Computer Generated
Hard Copy

## 1.4 QUALIFICATIONS

The manufacturer shall be a company specializing in the manufacture of products specified in this section for a minimum of 3 years.

## 1.5 PRELIMINARY DRAWINGS

Connection diagrams, riser diagrams, and floor plans shall be submitted indicating the relations and point-to-point connections (complete with actual terminal labels on terminal strips) of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, wiring, and other devices.

## 1.6 AS BUILT DRAWINGS

Connection diagrams, riser diagrams, and floor plans shall be submitted indicating the relations and point-to-point connections (complete with actual terminal labels on terminal strips) of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, wiring, and other devices.

Provide (1/8" - 1'-0")1:100 scale drawings to indicate installed locations for all audio equipment, speakers and wiring. Drawings shall be computer generated on size "F" sheets, using CAD software. Provide one hard copy, and one electronic copy in ".DXF" or ".DWG" format. The Contractor shall obtain electronic files of the building floor plan from the Contracting Officer. Indicate locations of the following equipment/components:

Amplifier
Speakers (all types)
Microphones
Cabinets
Racks

## 1.7 OPERATIONS AND MAINTENANCE MANUAL

The Contractor shall submit 6 copies of the Operation and Maintenance Manuals 30 days prior to testing. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Test data shall be legible. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals shall be bound in 3-ring, loose-leaf binders. Data shall be organized by separate index and tabbed sheets, in a loose-leaf binder. The binder shall lie flat with printed sheets that are easy to read. Caution and warning indications shall be clearly labeled.

## 1.8 DELIVERY, HANDLING, AND STORAGE

All equipment shall be delivered, stored, handled, and installed in a manner that will not damage the equipment. Equipment shall be stored indoors in the original unbroken, unopened containers bearing manufacturer's name, brand and UL label, in a clean, dry, and ventilated location.

During installation, equipment shall be protected from the weather.

# PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

General: The Paging and Area Warning system (P/AW) provides configurable zones for area warning; emergency, operational, and administrative paging; and alert capability for facilities at KSC. The system shall amplify sound

signals from cable plant low level lines and microphones, and distribute them to loud speakers at various locations.

The system shall interface and be compatible with the KSC Paging and Area Warning system. The respective support contractor in the area of the project shall make the final interfacing connection.

Functional Performance: Components and system features and functions shall include but are not limited to the following:

a. All Call Operation: Cable plant low level line input into the local facility paging system allowing area wide announcements to be broadcast by the KSC Duty Officer.

b. Microphone Station: The microphone will normally be used as an input device to permit broadcasting a message throughout the facility.

## 2.2 EQUIPMENT AND MATERIALS

General:

a. All equipment and materials shall be new and approved by Underwriters Laboratories, Inc.

b. Where 2 or more units of same class of equipment or materials are required, provide all units from single manufacturer.

### 2.2.1 Cabling

#### 2.2.1.1 System Cabling

Cabling shall be two conductor, twisted, shielded pair cables. Use plenum rated cable where cable is not installed in conduit.

Conductors shall be stranded copper, 1 pair twisted, with copper drain wire. Where not installed in conduit, use cable suitable for plenum application; NEC rating CMP. Conductors from the amplifier to the attenuator panel shall be #12 AWG. From the attenuator panel to the speaker, conductors shall be #16 AWG. Microphone cable shall be 2-pair, (one of the pairs shall be shielded), #20 AWG. Cable shall be rated 300 volts, with 90 degrees C temperature rating.

#### 2.2.1.2 Hook-Up Wire

Conductors shall be [20] [22] AWG, stranded, tinned copper, with aluminum polyester shield tape and tinned copper drain wire. Insulation shall be polyvinylchloride. Cable shall be rated 300 volts, with 80 degrees C temperature rating.

### 2.2.2 System Audio Equipment

All audio components shall be sized/rated to meet the requirements of, and be compatible with, the system as installed. The system shall be

coordinated with the COTR and base support contractors, to ensure proper interface with the base-wide Paging and Area Warning System.

2.2.2.1 Power Amplifier

Power rating shall be at <1 percent THD 50 Hz to 12 kHz; 70 volt balanced outputs. Frequency response shall be +0/-3 dB, 20 Hz to 20 kHz. Provide high impedance balanced inputs for 200/600/1000 ohm resistance. Protection shall be fail safe for output transistors. Input power shall be 120 V AC.

The power amplifiers shall be a modular card plug-in design with eight cards in each chassis. The chassis shall be not more than 178mm(7 inches) high and fit in a standard 483mm(19 inch) rack. Each power amplifier card shall have a 70 volt output with an efficiency of at least 80 percent at 200 watts output. Each power amplifier card shall be loaded to no more than 80 percent of rated output (that is, 160 watts). The system power shall be ample to drive speakers to 90 dB sound level.

2.2.2.2 Mixer-Amplifier

Mixing and distribution shall be accomplished in the audio processing shelf. The audio processing shelf shall accommodate at least 10 audio cards and shall be not more than 89mm(3.5 inches) high and fit in a standard 483mm(19 inch) rack. A test microphone for system testing shall be provided at the paging rack in the communications room.

Amplifier shall control and mix up to six (6) independent input signals, with up to +18 dBm output. Preamplifier microphone input module shall be designed for use with balanced low impedance microphones. Nominal gain setting shall be 40 dB for 100 mV rated output.

2.2.2.3 Attenuator (35 Watt)

Attenuator shall be rated 35 watt. Attenuation per step shall be 3 dB, with total attenuation at 30 dB. Insertion Loss shall be 0.6 dB. Provide with a matte black polycarbonate dial scale overlay with adhesive backing and including skirted black knob.

Attenuators shall be group mounted on aluminum plate in amplifier rack. Provide nameplate on each attenuator or identifying speaker group controlled.

2.2.2.4 Attenuator (75 Watt)

Attenuator shall be rated 75 watt. Attenuation per step shall be 3 dB, with total attenuation of 30 dB. Insertion Loss shall be 0.6 dB. Provide with a matte black polycarbonate dial scale overlay.

Attenuators shall be group mounted on aluminum plate in amplifier rack. Provide nameplate on each attenuator or identifying speaker group controlled.

2.2.2.5 Microphone

Microphone shall be dynamic, with push-to-talk thumb switch and one set of dry contacts. Rated impedance shall be (low) 150 to 200 ohms. Power level shall be 58 dB re 1 mW/100 kilopascals - EIA sensitivity - 151 dB. Frequency response shall be 100 to 8,000 Hz. An XLR-5 male connector shall be provided at the user end for connection to an interface box. Coil cord length shall be 300 mm retracted, 1800 mm extended. Cable shall be black neoprene, four conductor, (2 shielded) cable. Provide complete with mounting bracket. Maximum weight shall be 255 grams [_____].

2.2.3 Speakers

2.2.3.1 Ceiling and Wall Mounted Speakers

Speaker assembly shall include baffle-speaker-transformer, with wire volume control and enclosure. Transformer shall be rated 70.7 volts with primary taps for 0.5, 1, 2, 4 watts. Provide adjustable volume control. Speaker shall be 8-inch203 mm in diameter, with power handling capacity magnet, 96 dB sensitivity at 1200mm and frequency response of 30 Hz - 15 Hz. Ceiling grille shall be cold rolled steel with semi-gloss white enamel finish. Ceiling enclosure shall be constructed of heavy gauge cold rolled steel with heavy undercoating and finish with rust preventive coating. Ceiling enclosure shall be provided with mounting straps for attaching to supports of suspended ceiling. Wall speaker baffle shall be finished wood construction, wedge shaped to direct sound downward, with mounting bracket and wall attachment.

2.2.3.2 Equipment Area and Exterior Wall Mounted Horns

Horns shall be weatherproof fiberglass construction, with an adjustable "U" bracket for mounting. Loud speakers shall be wide angled paging projector with extended range woofer and high frequency compression driver. Power handling capacity shall be 15 watts with voice coil impedance of 8 ohms and produce sound pressure level of 117 dB at 4 feet1.2 m with 15 watt input. Dispersion at 2000 Hz shall be 66 degrees horizontal and 87 degrees vertical. Loud speaker assembly shall include 70/25 transformer with tap settings at 15, 7.5, 3.8, 1.9, 1.0, and 0.5 watts.

2.2.4 Equipment Cabinets

Equipment cabinets shall be constructed of 14 gauge CRS with 11 gauge CRS corner caster gussets, and 2 pairs of 14 gauge CRS adjustable mounting rails, zinc plated and punched 7 mm on EIA spacing. Cabinet depth shall be 25 inches, vertical space shall be 77.125 inches with mounting rails as required for all equipment installed. Frame shall be finished in black. Base shall accept leg levelers. Racks shall be provided with 16 gauge CRS perforated top panel. Rack shall contain an 18 gauge CRS lift-off side panel, which shall have provisions for securing. Doors shall be 16 gauge CRS mounted in 16 gauge CRS frame. CRS doors shall include cylinder lock, handle and hinge left. Horizontal and vertical trim shall be satin finish clear anodized aluminum. Single frame shall sit on leg levelers. The front door shall have Lexan panels (or approved equal) for equipment viewing without opening the door.

## 2.3 IDENTIFICATION LABELS

### 2.3.1 Equipment

Labels shall be laminated plastic with black background and engraved white lettering in accordance with Section 16003, "General Electrical Provisions". Permanently attach identification labels to front of electrical apparatus using sheet metal screws.

### 2.3.2 Cables

Cable labels shall be a polymide coated nylon cloth with a permanent acrylic pressure sensitive adhesive and a topcoat suitable for laser or write-on printing. Material shall offer solvent and smudge resistance.

# PART 3 EXECUTION

## 3.1 QUALIFICATIONS

The installer shall be a company specializing in installing products specified in this section.

## 3.2 EXAMINATION

The COTR shall examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the Paging and Area Warning system work.

Do not proceed until unsatisfactory conditions have been corrected.

## 3.3 LAYOUT

Contract drawings indicate extent and general arrangement of systems and equipment.

Submit all requests for changes in layout due to structural features, equipment location, and similar conditions to the Contracting Officer.

## 3.4 INSTALLATION

### 3.4.1 General

Comply with National Electrical Code and regulations of local agencies having jurisdiction.

Install all equipment/components in accordance with manufacturer's instructions.

Provide raceway system under provisions of Section 16145, "Standard Wiring Systems" of specification.

Ventilation and Cooling: Central paging equipment shall be installed in an environmentally controlled communications area. Install amplifiers in rack

to provide adequate ventilation air flow over top and bottom of each amplifier.

3.4.2 Cable

Install in conduits or through conduit sleeves as shown on drawings. Install fire seal in conduit sleeves through walls after cables are installed.

Install all horizontal distribution plenum cable between communications room and speaker assemblies above drop tile ceiling spaces conforming to plans and specifications. Provide cable supports as required to prevent cable from lying on suspended ceiling, lighting, piping or ductwork.

Make terminations in an organized workmanlike manner by trained and qualified personnel. Terminate conductors with crimp type ring lugs. Terminate shields with shield ferrules and shield rings.

On projects where audio equipment is not provided in the construction contract, neatly coil the cable with appropriate labeling in the equipment cabinet for future termination. Route low level lines (microphone lines and low signel level lines) a minimum of 12-in.305-mm away from 70 volt speaker lines and power lines.

3.4.3 Audio Equipment

Install all racks, cabinets, audio equipment, speakers, horns and all other system-specific equipment in accordance with plans and specifications. Securely mount to wall. There shall be no more than ten (10)speakers on a single zone circuit.

Label all equipment with proper name and designation.

3.5 GROUNDING

Provide equipment grounding connections on paging and area warning system as indicated. Tighten connections to assure permanent and effective grounds.

Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide electrical service ground at main equipment locations. Measure, record, and report ground resistance.

3.6 FIELD QUALITY CONTROL AND TESTING

Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

Pre-testing: Upon completing installation of the system, align, adjust, and balance the system and perform complete pre-testing. Determine through pre-testing, the conformance of the system to the requirements of the

Drawings and Specifications. Correct deficiencies that are observed in pre-testing. Replace malfunctioning or damaged items with new, and retest until materials satisfactory perform and conditions are achieved.

Testing: Upon completion of pre-testing, notify the Contracting Officer a minimum of 10 days in advance of acceptance test performance. Schedule and conduct tests in his presence. Provide a written record of test results.

Operational Test: Perform an operational system test to verify conformance of system to these Specifications. Perform tests that include originating program and page material at microphone outlets, all preamplifier program inputs, and all other inputs. Observe sound reproduction for proper volume levels and freedom from noise.

Acoustic Coverage Test: Feed pink noise into the system using octaves centered at 4,000 and 500 hertz. Use a sound level meter with octave band filters to measure the level at five locations in each zone. For spaces with seated audiences, the maximum permissible variation in level is plus or minus 2 dB and the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

Inspection: Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of speaker line matching transformers.

Retesting: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specification and complies with applicable standards. Provide a written record of all retest results.

Cable Tests:

After the system has been completely installed, the contractor shall remove each main 70V line shield one at a time from the single ground point and measure shield to ground resistance with a digital ohm meter and show a resistance of 10,000 ohms or greater. Record each reading on a data sheet and return the completed data sheet to the NASA contract engineer.

After the system has been completely installed, the contractor shall remove each 70V line, tip and ring, one at a time from the power amplifier and measure each conductor's resistance to ground with a digital ohm meter and show a resistance of 10,000 ohms or greater. Record each reading on a data sheet and return the completed data sheet to the NASA contract engineer.

After the system has been completely installed, the contractor shall remove each 70V line, tip and ring, one at a time from the power amplifier and measure the impedance between tip and ring with a 70V line impedance bridge, TOA model ZM-104 or equal, and show an impedance greater than the amplifier capability.
200 Watt amplifiers = Greater than 25 ohms total load.
150 Watt amplifiers = Greater than 33.3 ohms total load.
Record each reading on a data sheet and return the completed data sheet to the NASA Contracting Officer.

## 3.7 LABELING

### 3.7.1 Cabinets and Racks

Identify apparatus by specified name; for example "P/AW System Rack No. 1".

### 3.7.2 Terminal Strips

Letter and number on each terminal, for example "C1" through "C60", in sequence, top to bottom.

### 3.7.3 Speaker Attenuators

Letter and number each attenuator to identify associated speaker strings.

### 3.7.4 Cabling

All cables shall be labeled at each end with the zone or room number.

## 3.8 CLEANING AND PROTECTION

Prior to final acceptance, clean system components and protect form damage and deterioration.

-- End of Section --